Eucalyptus stoatei as a subspecies of *Eucalyptus forrestiana*

C. J. Robinson

Kings Park and Botanic Garden, West Perth, Western Australia 6005

Abstract

Robinson, C. J. *Eucalyptus stoatei* as a subspecies of *Eucalyptus forrestiana.* Nuytsia 5(2): 195-200 (1984). Morphometric data were collected from specimens across the known ranges of *Eucalyptus stoatei* and *Eucalyptus forrestiana.* Phenetic and numerical cladistic analysis of these data revealed *E. stoatei* to be more closely related to *E. forrestiana* subsp. *forrestiana* than is subsp. *dolichorhyncha.* This fact, combined with the observation that *E. stoatei* was originally described without a complete knowledge of the variation of *E. forrestiana,* has resulted in *E. stoatei* being reduced to the rank of a subspecies of *E. forrestiana.*

Introduction

During a survey by the author in 1979 to determine the conservation status of *Eucalyptus forrestiana* Diels, subspecies *forrestiana* and subspecies *dolichorhyncha* Brooker, it was observed that toward the western extreme of the range (Beard 1973) the bud and fruit morphology became progressively similar to, if not indistinguishable from that of *E. stoatei* C. A. Gardner. This situation was highlighted further when Hopper and Moran (1981) mapped eight populations of *E. stoatei* inside the western edge of Beard's range for *E. forrestiana.* Previously *E. stoatei* was considered to occur some forty kilometres west, only in the immediate vicinity of Jerdacuttup River (Chippendale 1973). Within the horticultural industry there has been confusion between the two species.

Eucalyptus stoatei differs from *E. forrestiana* in having irregular ribs on the hypanthium between four wings. The wings of *E. stoatei* are only discernible at the base of the hypanthium, just below the point of pedicellar attachment, becoming indistinguishable from the ribs at the staminal rim. The operculum in both *E. stoatei* and *E. forrestiana* subsp. *forrestiana* is domed while that of *E. forrestiana* subsp. *dolichorhyncha* is narrowly elongate. When Gardner (1936) described *E. stoatei*, he was not familiar with *E. forrestiana* as described by Diels (1904). Gardner (1933) considered the form with a long rostrate operculum (later described as subsp. *dolichorhyncha* by Brooker (1973) to be typical *E. forrestiana* and that Diels had described an aberrant form or that the long operculum beak had apparently been lost from the type specimen. The operculum apex of subsp. *forrestiana* is usually naturally scarred which Gardner (1933) misinterpreted as a scar of detachment of the beak. It is not surprising, therefore, that Gardner considered *E. stoatei* to be sufficiently different from *E. forrestiana* to warrant the rank of species.

This paper reports an investigation into the taxonomic relationship of specimens collected across the continuous range of both *E. stoatei* and *E. forrestiana* (including subspecies).

Method

For morphometric analysis, eighteen characters (Table 1) from up to twenty individuals from twenty-three populations (Figure 1) across the combined ranges of *E. stoatei* and *E. forrestiana* were measured. The gap between populations 1 to 4 and population 5 is due to extensive clearing for agriculture. The data were range coded (Hopper and Burgman 1983, p.37) and subjected to computer programs for:

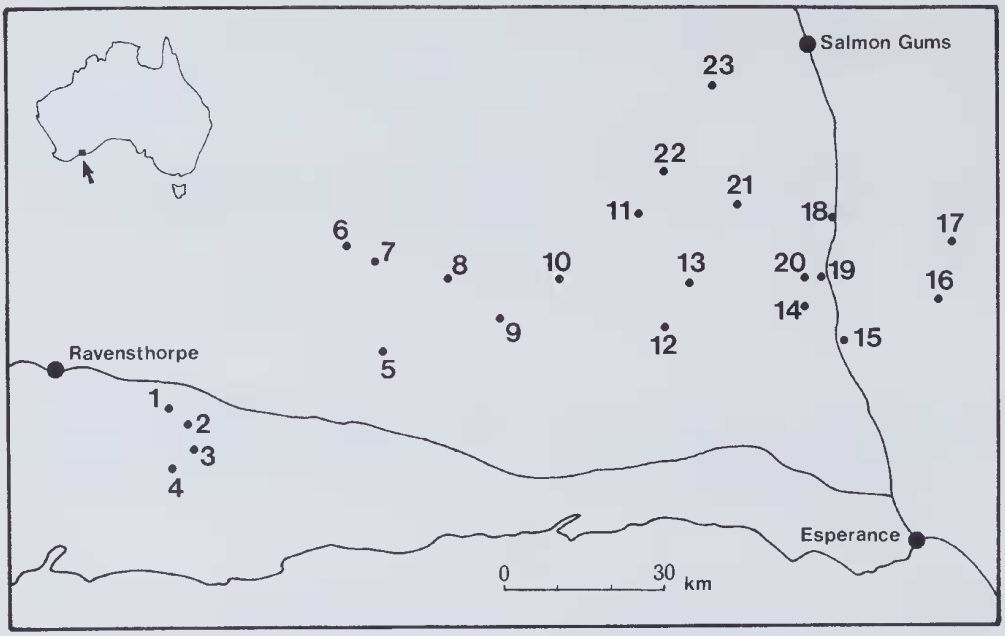

Figure 1. Map showing the locations of the numbered populations of *Eucalyptus forrestiana* s. lat.

1) phenetic analysis: the Euclidian distance measure was calculated between populations and a phenogram (Figure 2) was constructed using the WPGMA algorithm (Hopper and Burgman 1983, p.41).

2) numerical cladistic analysis: a Wagner network (Figure 3) was constructed using the shortest length approach (Hopper and Burgman 1983, p.37). The tree was rooted at the midpoint between the two most distant populations, which assumes rates of evolution are approximately equal along the two phyletic branches.

Leaf venation and seed characters were compared between all populations. Seeds from each population were germinated to compare cotyledon morphology. A voucher specimen from each population is lodged at PERTH.

Results and discussion

Phenetic analysis (Figure 2) separated the populations with grossly elongated opercula (i.e. *Eucalyptus forrestiana* subsp. *dolichorhyncha)* at a greater level of dissimilarity from all other populations. The remaining populations are separated into two further groups. The smaller group (populations 1 to 7) include populations from the Jerdacuttup River area and those further to the north east which Hopper and Moran (1981) considered to be *E. stoatei.* The remainder are populations of *E. forrestiana* subsp. *forrestiana.*

Numerical cladistic analysis (Figure 3) has resulted in a Wagner tree rooted such that the left and right branches contain approximately equal numbers of populations (eleven and twelve respectively). Populations from the range of *Eucalyptus stoatei* are at one branch end, whilst populations of *E. forrestiana* subsp. *dolichorhyncha* terminate the other. Populations of *E. forrestiana* subsp. *forrestiana* are spread evenly either side of the root. This suggests that both *E. stoatei* and *E. forrestiana* subsp. *dolichorhyncha* are monophyletic taxa with putative ancestors within *E. forrestiana* subsp. *forrestiana.*

Both the phenetic and cladistic analyses show *Eucalyptus stoatei* to be either more closely or equally related to *E. forrestiana* subsp. *forrestiana* than subsp. *dolichorhyncha*. No qualitative differences were observed in leaf venation, seed characters or seedling morphology.

It is apparent that all three taxa should have equal status. The rank of subspecies is appropriate since this study has revealed a species with a continuous range, without major topographical disjunction (excepting areas cleared for agriculture) over which minor morphological variation is maintained. Within the species range, three major groups (subspecies) are recognised and these are clearly linked by continuous intergradation. In the light of these results, plus the misinterpretation by Gardner (1933) of the nature of the operculum of typical *Eucalyptus forrestiana*, it is appropriate to reduce *E. stoatei* to the rank of a subspecies of *E. forrestiana*. The change is here effected:

Eucalyptus forrestiana subsp. **stoatei** (C. A. Gardner) C. J. Robinson comb. et stat. nov. Basionym: *E. stoatei* C. A. Gardner, J. Roy. Soc. W. Austral. 22: 126 (1936).

Obvious characters for distinction between the subspecies in the field are operculum length, rib number, rib depth, wing depth and leaf width. Subspecies *dolichorhyncha* has an elongated operculum (c. 20 mm long), no ribs, well developed bud wings (4-5 mm) and narrow leaves (17-20 mm wide). Subspecies *forrestiana* has a domed or bluntly pointed operculum (7-10 mm long), up to three or four poorly developed bud ribs (1-2 mm) between moderate wings (3-4 mm). The leaves are 20-25 mm wide. Subspecies *stoatei* has a similar operculum to subsp. *forrestiana,* but with 6-10 well developed ribs (3 mm) between wings of the same size and appearance as the ribs. The leaves of subsp. *stoatei* are broad (25-30 mm) and often shorter (65 mm) than the leaves of the other two subspecies (70-75 mm).

The three subspecies are geographically based with subsp. *stoatei* occupying the western part of the range, subsp. *forrestiana* the central and eastern part, and subsp. *dolichorhyncha* the northern fringe. Gradation between subspecies is illustrated in Figure 4, which clearly shows intermediate forms. The general habit of all subspecies is identical and all grow on sandy or gravelly clay over a clay subsoil.

Table 1. Characters measured for morphometric analysis.

Bud	Fruit	Leaf
peduncle length	no. ribs to staminal ring	thickness
hypanthium length	no. ribs to hypanthium shoulder	lamina length
operculum length	hypanthium length	lamina width
no. ribs to staminal ring	wing depth	petiole length
no. ribs to hypanthium	no. locules	
shoulder	staminal ring diameter	
wing depth		
rib depth		
operculum diameter		

Acknowledgements

M. I. H. Brooker and M. A. Burgman provided valuable comments on a draft manuscript. Burgman also assisted in the data processing and interpretation. The Western Australian Department of Fisheries and Wildlife provided facilities for field work and access to their mini computer. Field assistance was provided by R. B. Allen, J. M. Brown and G. J. Keighery. A. J. M. Hopkins gave logistic support and general encouragement.

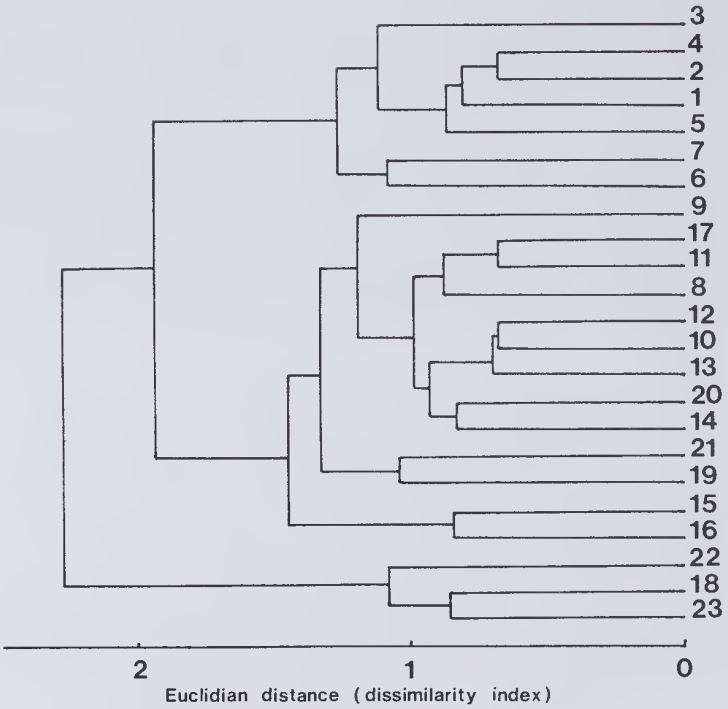

Figure 2. Phenogram of the numbered populations of *Eucalyptus forrestiana* s. lat.

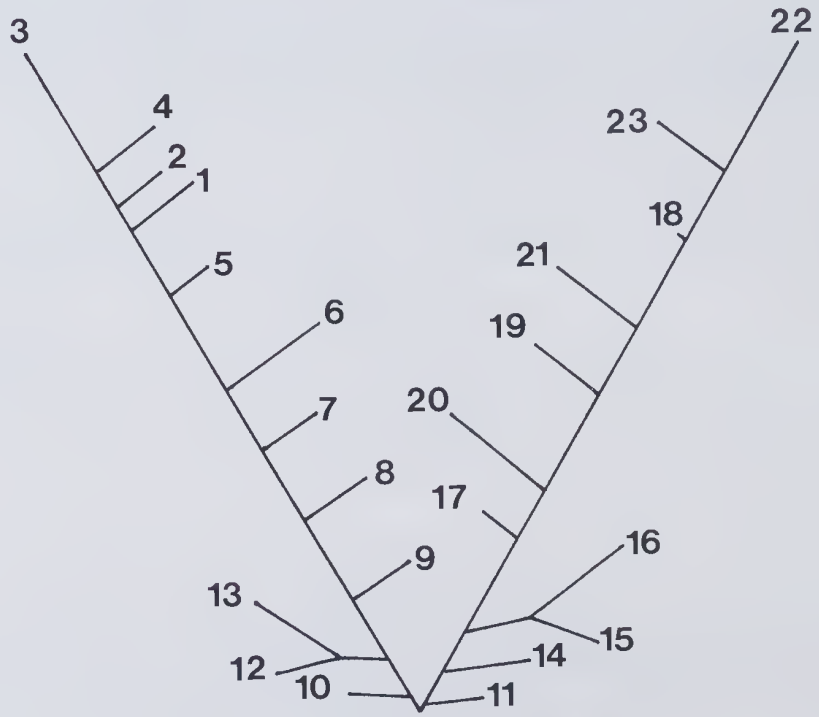

Figure 3. Wagner tree of the numbered populations of *Eucalyptus forrestiana* s. lat.

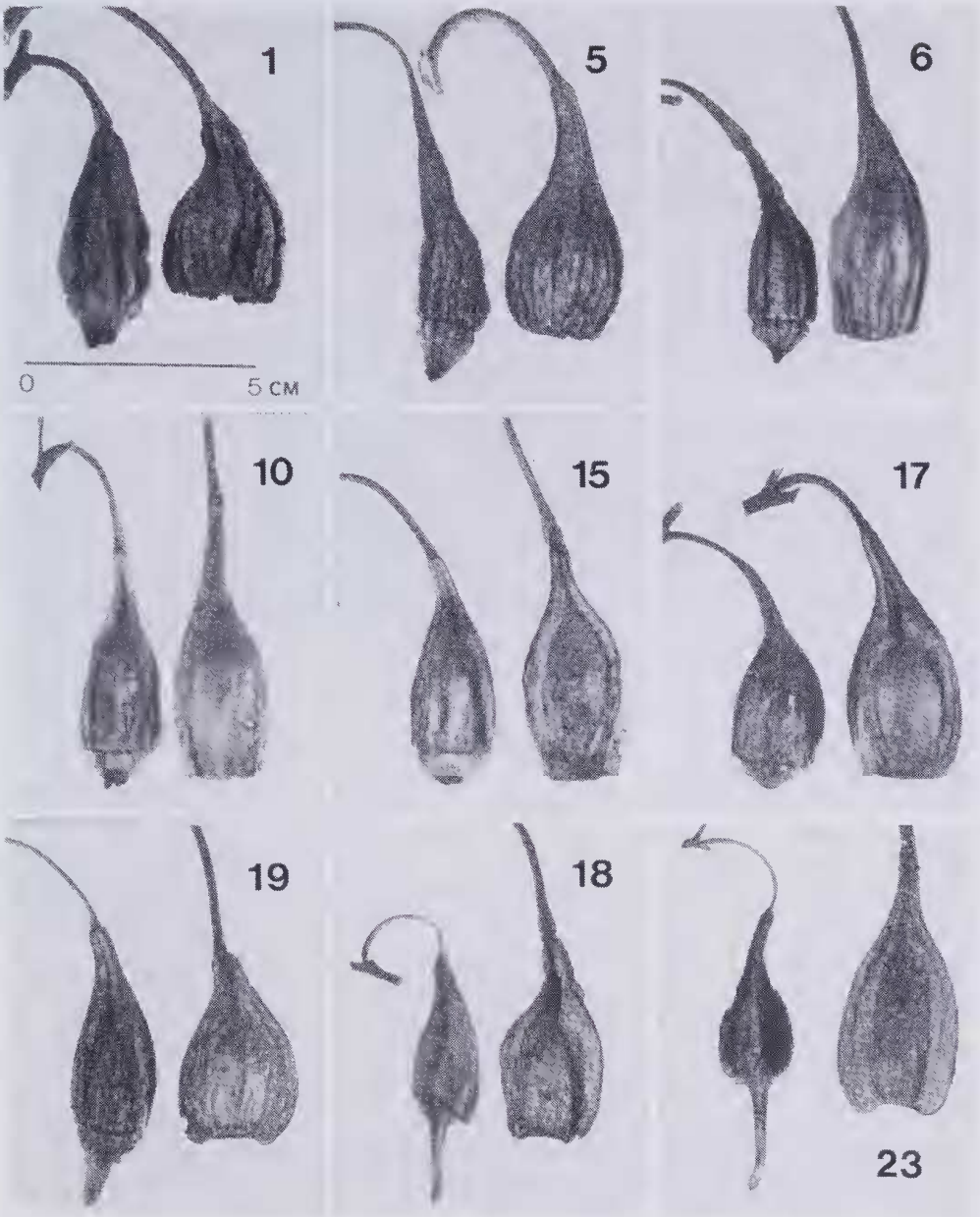

Figure 4. Bud and fruit pairs, each pair representing one of the numbered populations of *Eucalyptus forrestiana* s. lat.

References

Beard, J. S. (1973). The ecology and distribution of *Eucalyptus forrestiana* Diels. J. Roy. Soc. W. Austral. 56:76-77.

Brooker, M. I. H. (1973). *Eucalyptus forrestiana* subsp. *dolichorhyncha*, a new taxon from Western Australia. J. Roy. Soc. W. Austral. 56: 74-75

Chippendale, G. M. (1973). "Eucalypts of the Western Australian Goldfields". (AGPS : Canberra).

Diels, L. and Pritzel, E. (1904). Fragmenta Phytographiae Australiae occidentalis. Bot. Jahrb. Syst. 35: 55-662.

Gardner, C. A. (1933). Contributiones Florae Australiae Occidentalis No. 8. J. Roy. Soc. W. Austral. 19: 79-93.

Gardner, C. A. (1936). Contributiones Florae Australiae Occidentalis No. 9. J. Roy. Soc. W. Austral. 22: 119-127.

Hopper, S. D. and Burgman, M. A. (1983). Cladistic and phenetic analyses of phylogenetic relationships among populations of *Eucalyptus caesia*. Austral. J. Bot. 31: 35-49.

Hopper, S. D. and Moran, G. F. (1981). Bird pollination and the mating system of *Eucalyptus stoatei*. Austral. J. Bot. 29: 625-638.